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THE FORECAST OF THE PINE CREEK FLOOD OF MAY 26, 1987

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[Editor's Note: The following technical attachment by Giordano and Davis of WSFO Pittsburgh was recently published by the Eastern Region. It represents an excellent example of the coordinated use of mesoscale analysis, radar, and real-time data networks in issuing a successful heavy rain and flash flood forecast. Even though the event occurred far from our region, the techniques and data sources used apply in our region. Furthermore, the event occurred in an area of uneven terrain.]

EASTERN REGION TECHNICAL ATTACHMENT
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THE FORECAST OF THE PINE CREEK FLOOD OF MAY 26, 1987

By

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During the evening of May 26, 1987, 3 to 4 inches of rain within 5 hours caused flooding within the Pine Creek Basin and several other nearby watersheds 15 to 30 miles northeast of Pittsburgh. Ironically, this was just days before the first anniversary of the May 30, 1986 flash flood within the same Pine Creek Basin that killed 9 people when 8 inches of rain fell within 2 hours.

During the hours preceding the 1987 Pine Creek flood, NWS Pittsburgh took the following actions: 1) the 1030 AM State Forecast Discussion, 1100 AM Zone Forecast, and an 1145 AM Special Weather Statement highlighted the possibility of heavy rain causing flooding in the far western part of Pennsylvania, 2) a 400 PM Flash Flood Watch for 9 counties highlighted the area immediately northeast of Pittsburgh as one for particular concern, and 3) a 600 PM Flash Flood Warning highlighted the basins within this area most likely to get the flooding. These actions were possible, because the Pittsburgh staff was able to 1) recognize early that flooding was the "problem of the day" and 2) monitor the rain event concisely in real time via interactive use of skilled manual radar observations, RADAP-II rainfall estimations,. and IFLOWS rainfall observations. These are described below.

A. SYNOPTIC ANALYSIS

12Z raob data at PIT, as shown in Figure 1 by the AFOS program RUN:ANALYZ, and upwind at HTS and DAY showed fairly large instability (SI = -3; LI = -4) and excessive precipitable water (1.65 inches; 239 pct of normal). These were both due to the great amount of low-level moisture. The CCL around 830 mb (5700 ft MSL) was an indication that solar heating could be sufficient to trigger thunderstorms in the afternoon and evening.

The 12z 850 mb and 500 mb data (Figures 2 and 3) as well as surface data during the day (example, Figure 4) showed three synoptic features favorable for focusing the development of strong thunderstorms over eastern Ohio and far western Pennsylvania. These were: 1) a shallow front along the western slopes of the Appalachian Mountains that was to become a strong thermal boundary during the day due to the persistence of thick stratus and fog over the mountains, 2) a low-level wind that was perpendicular to this strong thermal boundary, and 3) a noticeable veering in the wind with height in the vicinity of the 500 mb ridge over eastern Ohio and far western Pennsylvania which signaled low-level warm advection and, therefore, increasing instability over the region. (Note, there was no short-wave trough aloft to initiate the upward motion during this situation, just low-level convergence).

As many an "experienced" forecaster knows, not every "dangerous-looking" situation produces dangerous weather, especially when the forecast is based on subtle features as the ones described. Yet each of us feels responsibility for alerting the public when we sense something bad could be coming. So the first response this day was to mention in the late morning forecast there could be heavy downpours and then to issue a statement describing the amounts of rain needed to produce various degrees of flooding and how repeated heavy thunderstorm rains were the tipoff for getting serious flooding troubles. This kind of statement can be considered a type of "self-serve watch". The second response was to internally step-up the monitoring of all available weather data--so that "official" watches and warnings for specific areas could be issued in a timely manner.

B. MANUAL RADAR OBSERVING TECHNIQUES

Because the NWS Pittsburgh staff was aware there could be flooding problems within its area, special techniques were incorporated into the radar observing routine to identify slow-moving thunderstorms within the ground clutter and regeneration of thunderstorms over specific areas. These special techniques were: 1) elevating the antenna sweep to diminish the effects of ground clutter, 2) carefully annotating the PPI scope or overlays at frequent intervals to determine individual storm movement and regeneration, and 3) coordinating this analog radar data with digital radar data from RADAP-II, IFLOWS observations, and surface aviation and SKYWARN observations.

Although at times, such techniques seem mundane, they were an important key in this situation. It was the manual radar observation at 345 PM of a thunderstorm regenerating within the ground clutter that prompted the issuance of the 400 PM Flash Flood Watch as it signaled that the 1.5 inch per hour rainfall observed by IFLOWS and estimated by RADAP-II could occur repeatedly enough over some areas that the 3-hourly Flash Flood Guidance of roughly 3 inches could be exceeded. Later on it was the tie-in of the PPI display with surface mesoanalysis (for example, Figure 5 which shows the extent of the outflow boundary) that helped the staff determine the short-term movement and development of storms prior to making warning decisions.

C. IFLOWS

It was IFLOWS, complemented by SKYWARN observations, that gave the early indication of just how heavy the downpours were that day. The IFLOWS automated rain gage at West Deer Park in Allegheny County, 20 NM northeast of PIT (Table 1 and Figure 6), showed 2.05 inches between 200 PM and 400 PM. This seemed to set up the outflow boundary that caused the thunderstorm regeneration manually observed on radar at 345 PM. As this outflow boundary moved further south--heavy rain began over the Penn State New Kensington IFLOWS gage in northwestern Westmoreland County with 1.70 inches falling between 400 PM and 500 PM and a total of 3.17 inches falling between 400 PM and 800 PM.

Figure 5 showed the heaviest rain after 500 PM (21Z) would be falling west of New Kensington as the outflow boundary moved further south and west. Unfortunately, this heavy rain band was in-between the IFLOWS gages in Allegheny County.

D. RADAP-II

With its Z-R estimations of peak rainfall within grid blocks 1 degree by 1 nautical mile every 12 minutes, RADAP-II showed three different areas had received 1 to 2 inches of rain between 200 PM and 400 PM. The RABID display program (Rainfall And Basin Information Display) on the ICRAD (Interactive Color Radar Display) showed these were Two Lick Creek Basin in Indiana County, Pucketa Creek Basin in Westmoreland County, and Pine Creek Basin in Allegheny County. This information was passed on to the appropriate County Emergency Operation Centers and highlighted in the 600 PM Flash Flood Warning.

Figure 6 is a plot of the B-scan RADAP-II rainfall estimation described above for the period from 400 PM to 700 PM. IFLOWS gages are identified by stars. RADAP-II did a good job in showing the location of the two peak rainfall locations. The first rainfall peak of 2.1 inches was in the Pucketa Creek Basin in the same bin as the Penn State New Kensington IFLOWS gage that reported 2.84 inches during this period. RADAP-II showed a second maximum of 2.4 inches in the Pine Creek Basin south of the North Hills IFLOWS gage. Considering the underestimation of the rainfall at the New Kensington gage, the actual peak rainfall within the Pine Creek Basin could have been as much as 3 1/2 inches during this 3-hour period. Since the band of heavy rainfall was falling between IFLOW gages, these estimates were crucial in determining if the Flash Flood Guidance had been exceeded.

It was this interactive use of synoptic analysis, manual radar observations, IFLOWS, and RADAP-II that resulted in the timely and specific forecasting of this particular flood event.

SCIENTIFIC SERVICES DIVISION, ERH
August 4, 1987

Attachments (Figures 1 through 6)

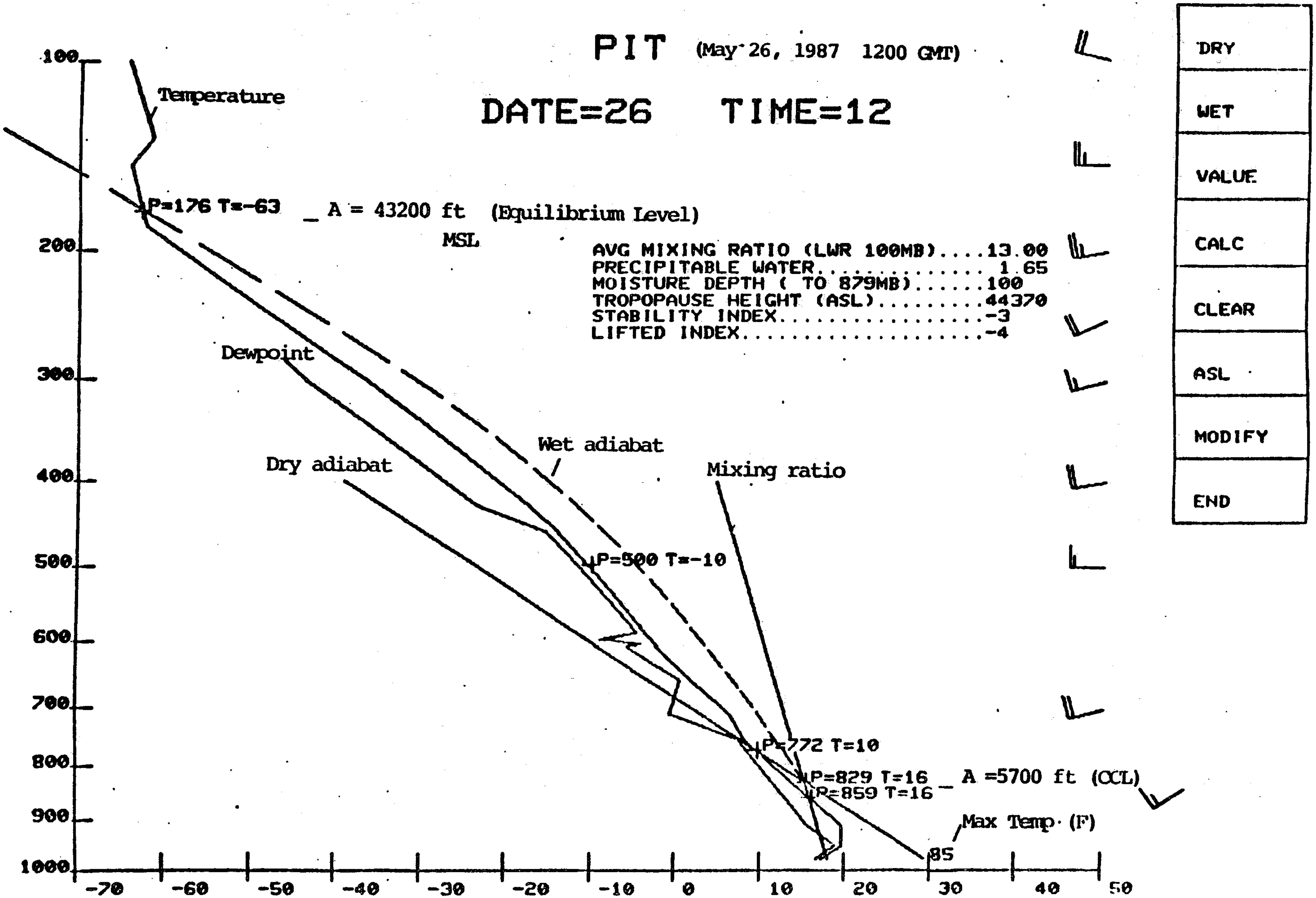

Figure 1. Pittsburgh rawindsonde observation, 1200 GMT 05-26-87.

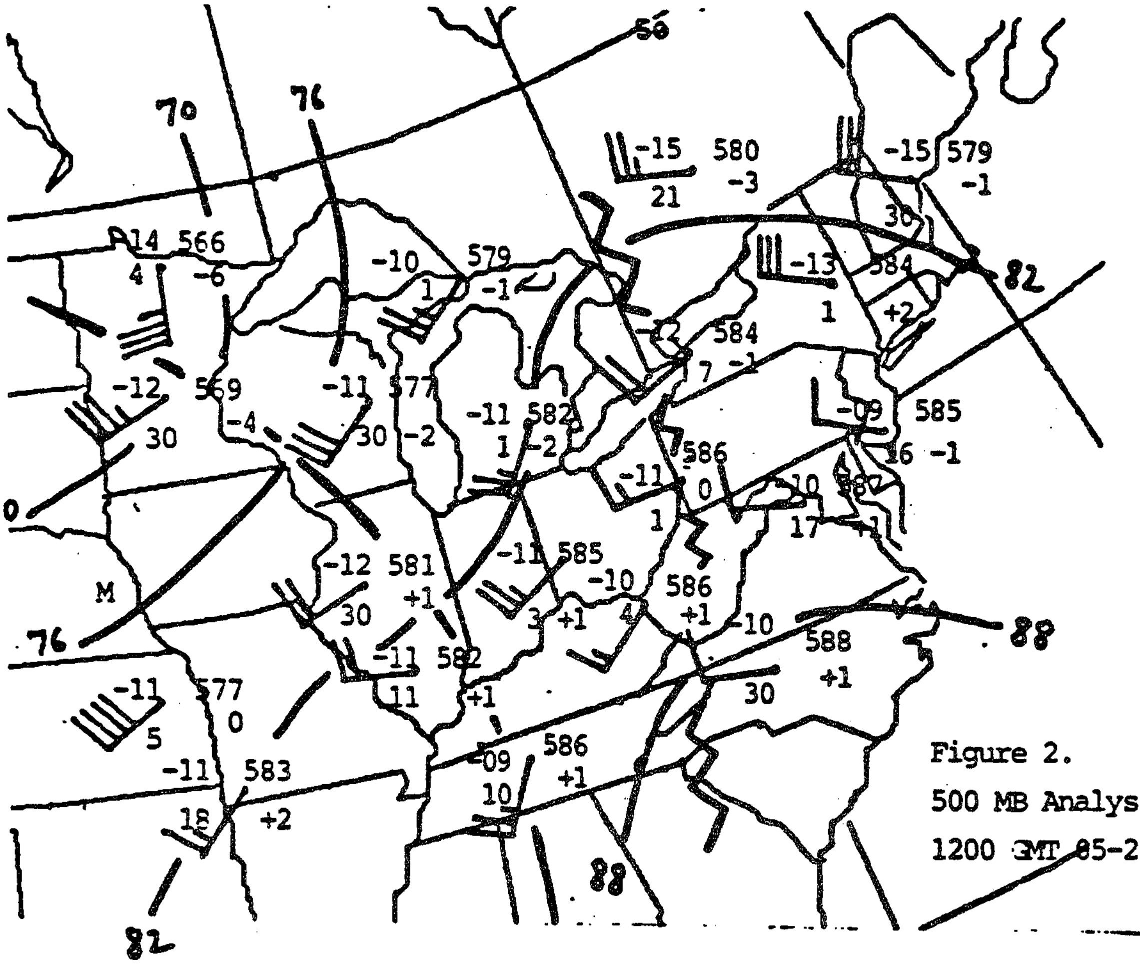

Figure 2.
500 MB Analysis
1200 GMT 05-26-87

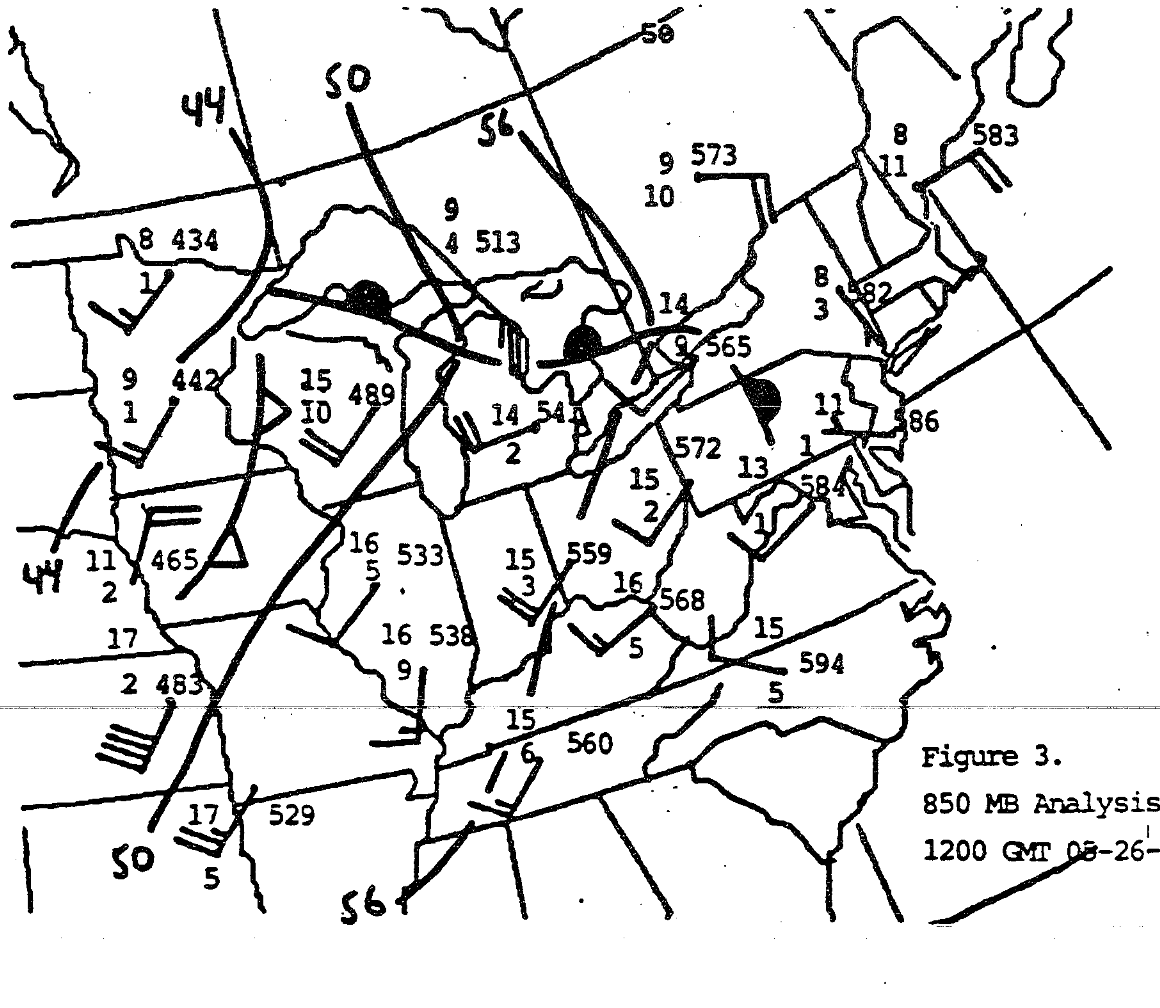

Figure 3.
850 MB Analysis
1200 GMT 05-26-87

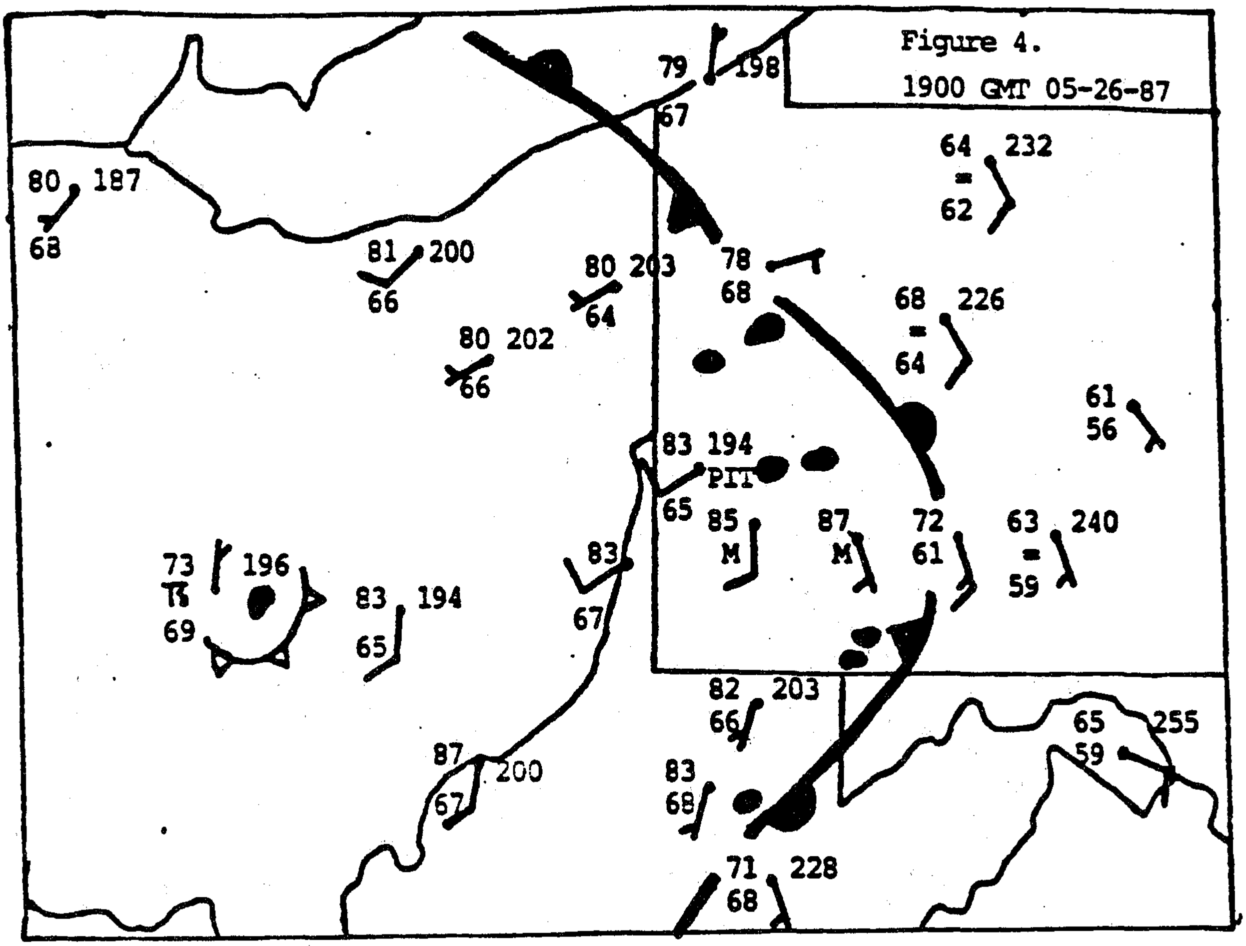

Figure 4.
1900 GMT 05-26-87

Note: In both figures, radar echoes VIP 3+ are shaded; max VIP also located Fig. 5.

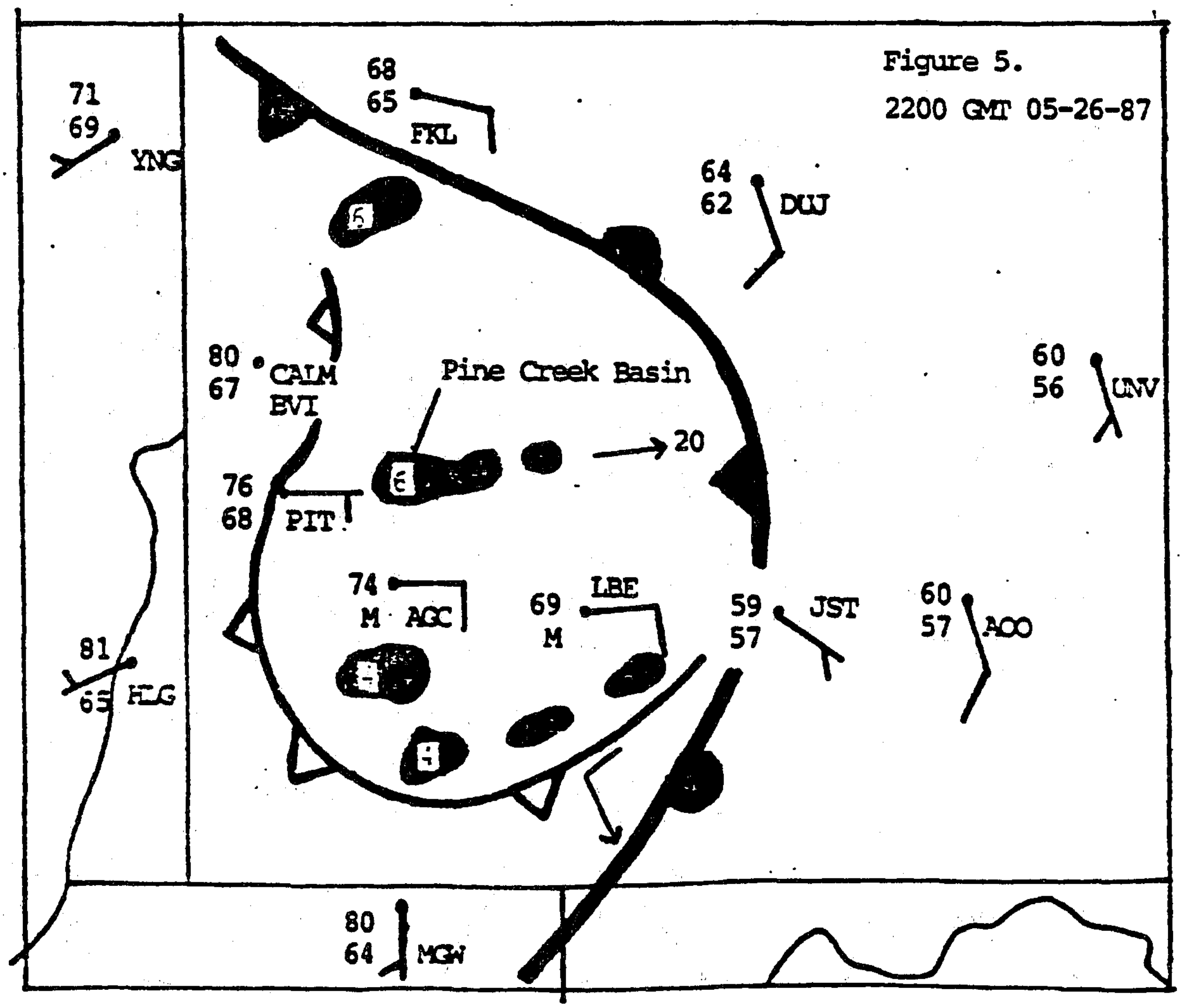

Figure 5.
2200 GMT 05-26-87

Table 1. IFLOWS 05-26-87

Rainfall Ending At 05/26/87 20:00 EDT, Run At 07/11/87 11:54 EDT Page 1

LID	ST	COUNTY	Name	Start: 05/26 19:00 End: 05/26 20:00	Start: 05/26 18:00 End: 05/26 19:00	Start: 05/26 17:00 End: 05/26 18:00	Start: 05/26 16:00 End: 05/26 17:00	Start: 05/26 15:00 End: 05/26 16:00	Start: 05/26 14:00 End: 05/26 15:00	Start: 05/26 13:00 End: 05/26 14:00	Total
2541	PA	ALGHNY	SO HILLS VILLAGE	-	-	-	-	-	0	-	0
2542	PA	ALGHNY	CASTLE SHANNON	-	-	-	-	-	-	-	0
2543	PA	ALGHNY	HOLIDAY PARK	0.44	0.20	0.08	0.08	-	-	-	0.80
2544	PA	ALGHNY	NORTH HILLS	0.08	0.56	0.52	0.04	0	-	-	1.20
2545	PA	ALGHNY	PLEASANT HILLS	-	0.04	-	-	0.08	-	-	0.12
2546	PA	ALGHNY	WEST DEER PARK	0.79	0.32	0.04	0	1.34	0.71	0.08	3.28
2547	PA	ALGHNY	HAMPTON TWP MUN	-	-	-	-	-	-	-	0
2548	PA	ALGHNY	BEECHWOOD FARMS	-	-	-	-	-	-	-	0
2531	PA	WTMRLD	PENN ST-NEW KENS	0.32	0.71	0.43	1.70	0.08	-	-	3.24
2532	PA	WTMRLD	DELMONT	0	-	-	-	-	-	-	0
2533	PA	WTMRLD	FAIRVIEW	-	-	-	-	-	-	0	0
2534	PA	WTMRLD	ST. BONIFACE	0.12	0.55	1.50	-	-	-	-	2.17
2535	PA	WTMRLD	RACHELWOOD	0.08	0.71	0.48	0.08	-	-	-	1.35
2536	PA	WTMRLD	LAUREL MTN. PARK	-	-	-	-	-	-	-	0
2537	PA	WTMRLD	NEW STANTON	0.16	0.16	0.67	-	-	-	-	0.99

Rainfall Ending At 05/26/87 19:00 EDT, Run At 07/11/87 11:56 EDT Page 1

LID	ST	COUNTY	Name	Start: 05/26 18:00 End: 05/26 19:00	Start: 05/26 17:00 End: 05/26 18:00	Start: 05/26 16:00 End: 05/26 17:00	Total
2541	PA	ALGHNY	SO HILLS VILLAGE	-	-	-	0
2542	PA	ALGHNY	CASTLE SHANNON	-	-	-	0
2543	PA	ALGHNY	HOLIDAY PARK	0.20	0.08	0.08	0.36
2544	PA	ALGHNY	NORTH HILLS	0.56	0.52	0.04	1.12
2545	PA	ALGHNY	PLEASANT HILLS	0.04	-	-	0.04
2546	PA	ALGHNY	WEST DEER PARK	0.32	0.04	0	0.36
2547	PA	ALGHNY	HAMPTON TWP MUN	-	-	-	0
2548	PA	ALGHNY	BEECHWOOD FARMS	-	-	-	0
2531	PA	WTMRLD	PENN ST-NEW KENS	0.71	0.43	1.70	2.84
2532	PA	WTMRLD	DELMONT	-	-	-	0
2533	PA	WTMRLD	FAIRVIEW	-	-	-	0
2534	PA	WTMRLD	ST. BONIFACE	0.55	1.50	-	2.05
2535	PA	WTMRLD	RACHELWOOD	0.71	0.48	0.08	1.27
2536	PA	WTMRLD	LAUREL MTN. PARK	-	-	-	0
2537	PA	WTMRLD	NEW STANTON	0.16	0.67	-	0.83

Figure 6. B-SCAN rainfall 400-700 PM EDT 05-26-87.